



# **City of Salina Raw Water Supply Study**

**Citizen's Advisory Board  
Workshop**

**November 13, 2008  
6:00 PM**

**HDR**



# Introductions



- City Staff
  - Martha Tasker, Director of Utilities
  - Kurt Williams, Plant Operations Manager
  - Jeff Cart, Water Distribution Supervisor
  - Steve Palmer, Utility Engineer
- Consultants
  - HDR
    - Donald Lindeman, Project Manager
    - Lorrie Hill, Project Engineer
  - Wilson & Company
    - Jason Schlickbernd, Asst. Project Manager

Questions?

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# Introductions



- Citizens Advisory Board Members



Dan Ade

Todd Anderson

Gina Bell

Robert Bostater

Beth Eisenbraun

Tim Hobson

Mike Hulteen

Brian Kinnaird

Harold Klaege

James Maes

Charles May

John Ourada

Lawrence Wetter





# Agenda for Tonight



- Review of Study Objectives
  - Purpose of Citizens Advisory Board
  - Scope of the Raw Water Supply Study
- Regulatory Meeting Summary
- Future Regulatory Impacts
- Review of Existing Sources of Supply
- Optimization of Existing System
  - Optimization of South Wellfield
  - Conjunctive Use
  - Recharge of Wellfields





# Review of CAB Process

- Citizens Advisory Board (CAB)
  - Give citizens input in planning for future
  - Provide ideas, concepts, and recommendations
  - Have an open mind and broad vision to do what is best for Salina as a whole
- Meeting Format
  - Interactive power point presentation
  - Answer questions
  - Input from CAB/discussion
- CAB meetings at key project milestones
  - August, 2008 - Demand projections, water rights
  - November, 2008 – Future regulatory impacts, existing facilities
  - December, 2008 - Conservation, reuse
  - January, 2009 - Alternatives





## Purpose of Study



- Recent drought conditions
- Contamination issues near wellfields
- Strained ability of City to maintain adequate water supply for customers
- Identify sustainable solutions for next 50 years
- Diversify water supply sources





## Scope of Study



- Water Demand Projections— July, 2008
- Water Rights and Regulatory Review – Sept, 2008
- Review of Existing Sources of Supply – Oct, 2008
- Conservation Plan – Nov, 2008
- Reuse Evaluation – Nov, 2008
- Alternatives Evaluation – Jan, 2009





# Discussion/Questions





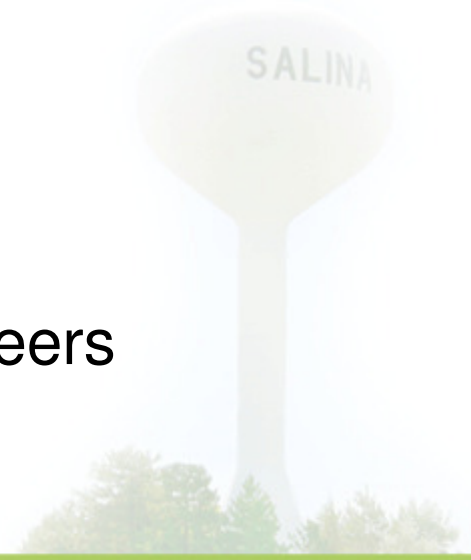
# Regulatory Meeting Summary





# Regulatory Meeting Summary

- Meeting with regulatory agencies of the State of Kansas
  - Division of Water Resources
  - Kansas Department of Health and Environment
    - Public Water Supply
    - Municipal
    - North Central District
    - Bureau of Remediation
  - Kansas Water Office
  - Kansas Farm Bureau
  - United States Army Corps of Engineers





## Regulatory Meeting Summary (continued)

- Purpose of meeting:
  - Introduce the challenges the City faces and potential solutions to the regulatory agencies
  - Understand regulatory impacts
  - Understand future availability of potential new sources and considerations
- Topics of meeting
  - Future drinking water regulations
  - Remediation of groundwater contamination
  - Incorporating private wells into conservation plan
  - Water reuse
  - Options for new sources of supply





# Recent/Future Regulatory Impacts





## Stage 2 Disinfection By-Products Rule

- Changes disinfection by-product compliance (DBP) to be based on locational running averages instead of averaged across the whole distribution system
- Complete an Initial Distribution System Evaluation (IDSE)
  - Locate new sampling points for total trihalomethanes (TTHMs) and haloacetic acids (HAA5s)
- Final compliance by October 1, 2013
- Treatment alternatives and operational changes may be necessary to reduce TTHM and HAA5 formation



## Long-Term 2 Enhanced Surface Water Treatment Rule

- Applies to surface water or GWUDI
  - For Salina, only applies to Smoky Hill River source
- Sampling of raw water source for *Cryptosporidium*
- Generally based on sample results further disinfection may be required
- Current monitoring indicates no further treatment
- Compliance deadline is 2011





## Long-Term 2 Enhanced Surface Water Treatment Rule (continued)

- Effect on new sources of supply
  - Monitoring of the new source would be required on a schedule that KDHE approves
  - KDHE could require monitoring to be completed prior to bringing the source online
  - Monitoring of new sources must meet requirements of the rule
  - If there are changes to the bin classification, KDHE will determine the schedule for compliance





# Contaminant Candidate List

- EPA periodically publishes a contaminant candidate list (CCL)
  - Identifies contaminants that are known or anticipated to occur in drinking water systems
  - Conduct research to determine what regulations are needed
- Current list is third CCL (CCL 3) – in draft stage
  - Contains 93 chemical contaminants and 11 microbiological contaminants
- At this time no impact on Raw Water Supply Study



# Total Coliform Rule Revisions

- Scheduled for proposal in 2010 with final rule by 2012
- Goals of the revisions:
  - Trigger systems with positive total coliform/E. coli monitoring results to do a system assessment
  - Remove fecal coliform maximum contaminant level
  - Remove total coliform maximum contaminant level, but keep as an indicator of sanitary defects
- Currently no impact on Raw Water Supply Study





# Lead and Copper Rule Revisions

- EPA currently developing issue papers
- Revisions potentially proposed in 2009
- At this time, no impact on Raw Water Supply Study





# Discussion/Questions





# Existing Sources of Supply

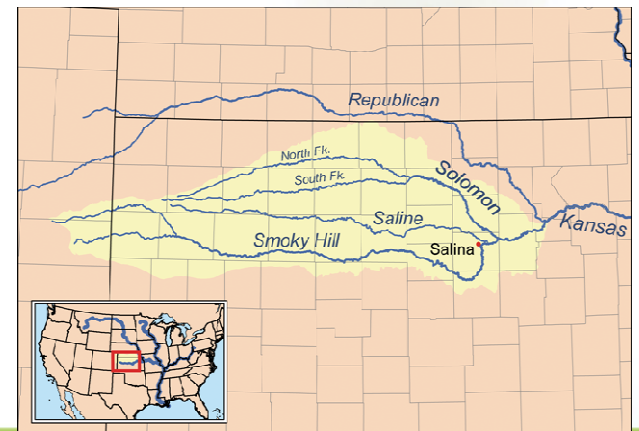
## Smoky Hill River





## Smoky Hill River - General

- Two reservoirs – Cedar Bluff, Kanopolis
- Two major tributaries – Saline and Solomon
- Flow in Smoky Hill River at Salina controlled by:
  - Releases from Kanopolis Lake
  - Precipitation/runoff events
  - Upstream diversions (irrigation)
  - Interflow between alluvial aquifer and river
- Gaining stream vs. losing stream
- City has water rights for 10 MGD



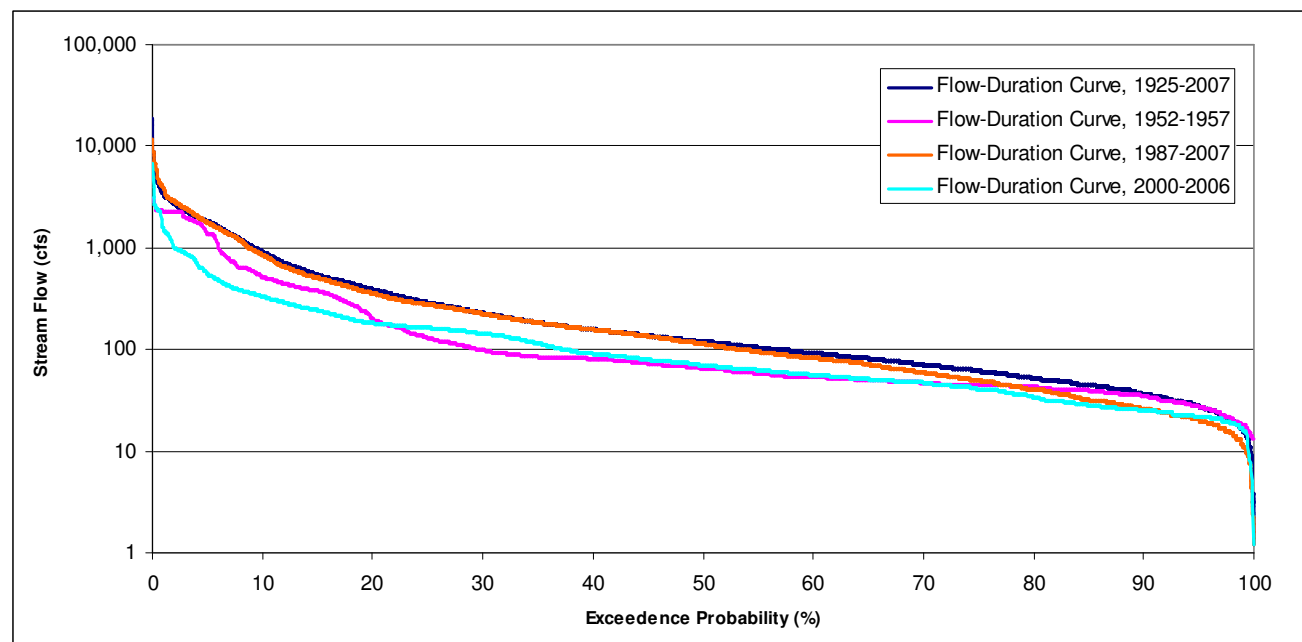


# Stream Flow Trends

- USGS stream flow gage at Mentor, Kansas
- Lowest stream flow of record – July 2006
  - 1.2 cfs (0.82 MGD)
- Overall trend of declining stream flows over time

75% Exceedence:  
1925-2007 = 62  
1952-1957 = 45  
1987-2007 = 50  
2000-2006 = 41

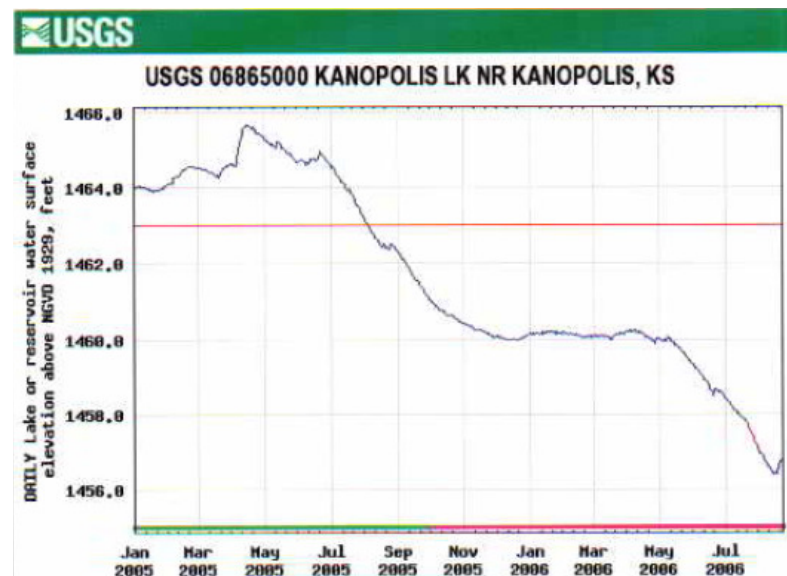
90% Exceedence:  
1925-2007 = 37  
1952-1957 = 35  
1987-2007 = 26  
2000-2006 = 25





# Kanopolis Reservoir Releases

- Water released from reservoir by USACE
- Low lake levels in 2006
- Kansas Water Office requested USACE for deviation in the minimum release schedule
- Minimum releases between 10 cfs and 20 cfs
- Request dropped after lake levels recovered in 2007





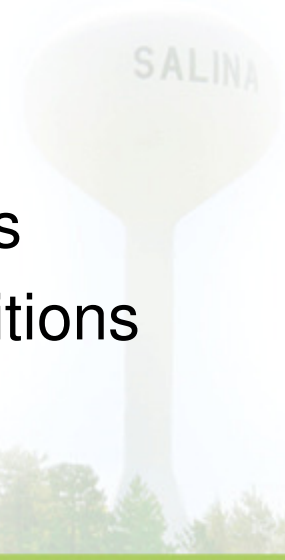
## Kanopolis Reservoir Releases (continued)

- KWO believes there is a better way to operate releases from Kanopolis
- KWO working with USACE to optimize releases
- 3 alternatives identified to meet downstream needs while lessening impact on lake levels
- Alternative 1: Current release schedule (modified)
  - Apply current release schedule (water quality pool)
  - If downstream needs are not met, bypass inflows
  - If downstream needs still not met, release from water supply pool
- Alternative 2: Improved release schedule
- Alternative 3: Make releases to meet downstream needs



# Water Quality

- Overall quality is suitable for water supply (evidenced by historical treated water quality data)
  - Hardness averages 313 mg/L
    - Treated to approx 110 mg/L
  - Total Dissolved solids averages 659 mg/L
    - Treated to approx 576 mg/L
  - Iron averages 1.91 mg/L
    - Treated to <0.010 mg/L
  - Turbidity averages 46 NTU
    - Treated to <0.15 NTU
- TDS may be concern in low flow conditions
- Turbidity is an issue during high flow conditions





# Withdrawal Procedures

- River intake on Smoky Hill River
- Raw water pump station – 10 MGD capacity
- 24-inch raw water pipeline to water treatment plant
- Standard procedures for withdrawal:
  - Based on turbidity and temperature
  - If turbidity is  $>300$  NTU discontinue use
  - During cold temperatures some water from wellfield is blended to increase the temperature





# Discussion/Questions





# Downtown Wellfield





## Water Rights



- 15 wells in the Smoky Hill River alluvial aquifer
- Maximum flow limit – 13.13 MGD
- Downtown Wellfield is fully appropriated
  - No new water rights authorized
  - Replacement wells may be drilled with same restrictions as the wells they replace





# Well Capacity Estimates



- Field performance tests by Layne Christensen in May 2007



- Objectives of testing:
  - Determine specific capacity (based on drawdown observed at well)
  - Project a maximum pumping rate for the well
- Wells should be capable of producing 800 to 1,200 gpm each





# Well Capacity Estimates (continued)

Well #	Recommended Pumping Rate (gpm)	Water Right Flow Rate Limit (gpm)	Difference Between Pumping Rate and Water Right (gpm)
1	440	870	430
2	295	1,085	790
3	850	1,000	150
4	310	1,160	850
5	175	1,000	825
6	365	1,140	775
7	405	1,215	810
8	525	1,140	615
10	450	1,310	860
11	720	1,195	475
12	835	1,270	435
13A	930	1,160	230
14	845	1,085	240
15	400 *	965	565
16	875	905	30
Total	8,420	16,500	
Limits		9,118	

12.12 MGD      13.13 MGD





# Drought Impacts

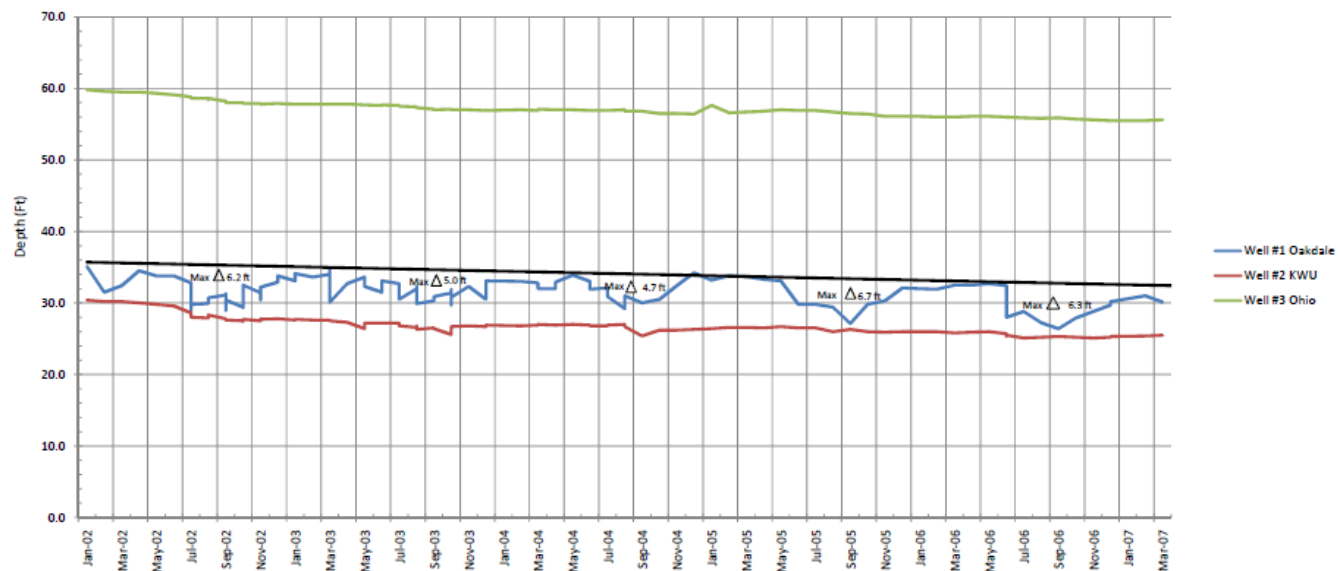
- City operates 3 observation wells
  - Oakdale (within wellfield)
  - KWU (outside of wellfield)
  - Ohio Street (outside of wellfield)
- Long-term water level data
- Level in aquifer is a function of the stage in the river





## Drought Impacts (continued)

- Declining trend in water level in aquifer from 2002 to 2007
- Water level decline occurs in direct response to pumping of the wellfield
- Water levels in aquifer are lowest during the times when they are most needed (summer months)





# Water Quality



- Overall quality is suitable for water supply (evidenced by historical treated water quality data)
  - Hardness averages 629 mg/L
    - Treated to approx 110 mg/L
  - Total Dissolved solids averages 969 mg/L
    - Treated to approx 576 mg/L
  - Iron averages 0.26 mg/L
    - Treated to <0.010 mg/L
  - Manganese averages 0.4 mg/L
    - Treated to <0.001 mg/L





# Groundwater Contamination



- Groundwater contamination plume affecting wells 11, 12, 15, 16
  - Mostly due to past dry cleaner activity
  - 1,2 DCA seen as high as 16 ppb at these wells
  - City's air strippers treat up to 4 ppb
  - City has currently discontinued use of these wells
- KDHE studying how to contain the contamination and stop it from impacting water supply wells
  - Groundwater model
  - Studying various alternatives





## Groundwater Contamination (continued)



- KDHE recommendations:
  - Install capture well to intercept contamination prior to reaching wells
  - Pump capture well at 300 gpm with a Granular Activated Carbon system to treat
  - Then pump to water treatment plant for further treatment
  - Water for City consumption
  - Wellfield as a whole will experience reduced pumping capabilities
    - On average, wellfield loses 120 gpm of pumpage (as a whole)
    - Reduced pumpage unknown for peak conditions





# Discussion/Questions





# South Wellfield





## Water Rights



- 5 wells in the Smoky Hill River alluvial aquifer
  - Only 3 have pumps installed
- Maximum flow limit – 3.68 MGD
- New water rights available in vicinity of South Wellfield
- Replacement wells may be drilled





## Well Capacity Estimates



- No recent performance testing for existing wells to determine recommended pumping rates
- Installed capacities:
  - Well #1 = 730 gpm
  - Well #2 = 380 gpm
  - Well #5 = 450 gpm
  - Total = 1,560 gpm (2.25 MGD)
- Recommend performance testing to determine recommended pumping rates
- Wells should be capable of producing 500 to 800 gpm each





## Drought Impacts



- No data available to assess drought impacts on aquifer levels
- Level in aquifer is a function of the stage in the river
- Wells spaced further apart than Downtown Wellfield
  - Likely less reduction in pumping rates





# Water Quality

- Currently no treatment of water produced by wellfield other than chlorination
  - Hardness averages 431 mg/L (629 mg/L at DT Wellfield)
    - Other sources treated to approx 110 mg/L
  - Total Dissolved solids averages 688 mg/L (969 mg/L at DT Wellfield)
    - Other sources treated to approx 576 mg/L
    - Secondary standard is 500 mg/L
  - Iron averages 0.4 mg/L (0.26 mg/L at DT Wellfield)
    - Smoky Hill River/Downtown Wellfield treated to <0.010 mg/L
    - Secondary standard is 0.3 mg/L
  - Manganese averages 1.15 mg/L (0.4 mg/L at DT Wellfield)
    - Other sources treated to <0.001 mg/L
    - Secondary standard is 0.05 mg/L



# Groundwater Contamination



- Groundwater contamination plume 2.5 miles northwest of South Wellfield
  - Originates from Schilling Air Force Base
  - Being monitored and studied by the USACE
- Movement is to the northwest, away from South Wellfield





# Discussion/Questions



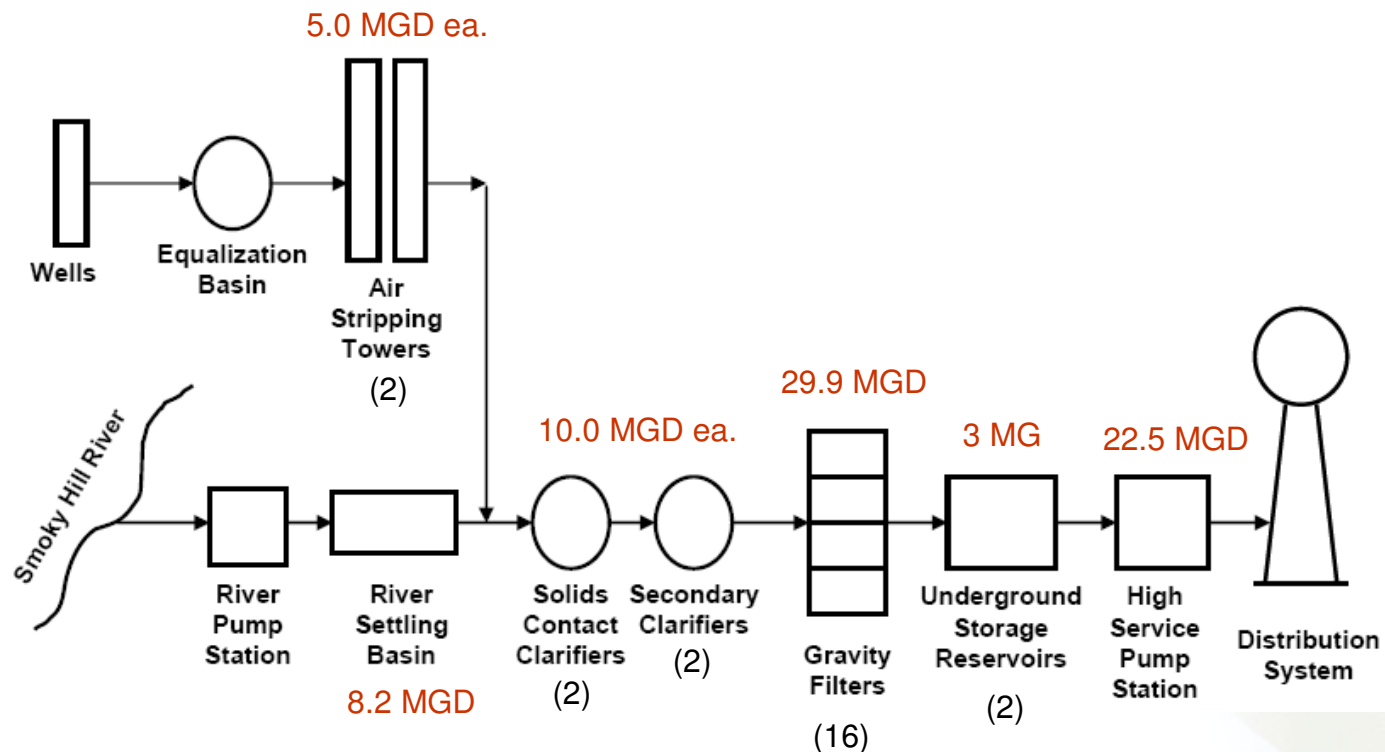


# Existing Facilities Evaluation





# Water Treatment Facility



Reliable capacity (one treatment unit out of service)  
of the water treatment plant needs to be considered



# Distribution System



- Hydraulic modeling done by Professional Engineering Consultants in 2007

- Planning horizon 2030
- Different projected demands



- Conclusions:

- Available fire flows inadequate for a majority of the City
- Additional water storage is required for both present and projected 2030 conditions
- Water age in distribution system is adequate
- Some portions of the system experience taste & odor problems and/or low chlorine residuals
- System pressures are adequate for average day, maximum day, and peak hour

- Conclusions unknown using Raw Water Supply demand projections and 2060 planning horizon



# Discussion/Questions





# Existing System Deficiencies



- Raw Water Supply Sources

- Supply from river during drought conditions is decreased
- Aquifer recharge not sufficient
- Currently no control over private wells within City
- Well pump capacities are reduced when aquifer levels are low
- Presence of contamination at Downtown Wellfield limits use
- Wells that date back to 1930s have problems with fouling
- South Wellfield not used due to water quality issues





## Existing System Deficiencies (continued)



- Water Treatment Facility

- Components with a reliable capacity of less than 20 MGD
  - Air stripping towers
  - River settling basin
- Seasonal taste and odor issues with use of river
- River settling basin unable to treat turbidity greater than 300 NTU



- Additional Considerations

- No additional space at existing facility
- Account for future water quality regulations
- Additional treatment may be needed if new sources are brought on-line





## Existing System Deficiencies (continued)



- Water Distribution System
  - Available fire flows inadequate for most of City
  - Additional water storage is required
  - There are taste and odor problems and/or low chlorine residuals in some areas





# Recommendations for Existing Sources of Supply

- Primary goal – maximize use of existing water supply
- Smoky Hill River
  - Increase use during off-season times
  - Obtain a seasonal water right
- Downtown Wellfield
  - Current pumping capabilities below water right allowance
    - 12.12 MGD pumping vs. 13.13 MGD water right
    - Redrill wells
      - Wells that have exceeded their design life
      - Wells with a large difference between capacity and water right
    - Replacement wells should be capable of producing at least 800 gpm

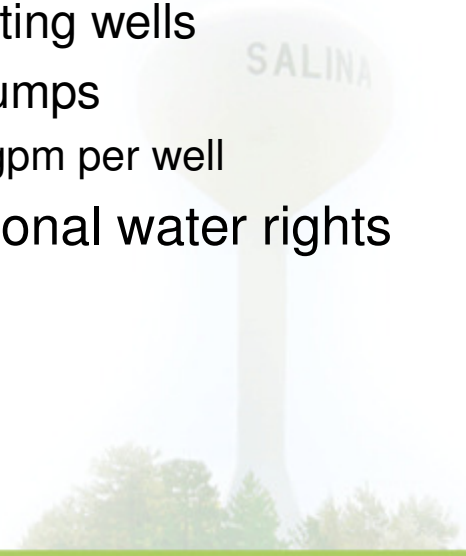


# Recommendations for Existing Sources of Supply (continued)



- South Wellfield

- Construct a water treatment facility
  - High hardness increases soap consumption, scaling
  - Iron and manganese taste bitter and can stain
  - Treatment scheme to remove hardness, iron, manganese
- Existing infrastructure does not maximize water right
  - 3 wells can produce 2.24 MGD compared to 3.68 MGD water right
  - Do performance testing to evaluate the existing wells
  - Redrill the existing wells that do not have pumps
    - Should be capable of producing 500 – 800 gpm per well
- Opportunities to expand by obtaining additional water rights





# Recommendations for Existing Sources of Supply (continued)



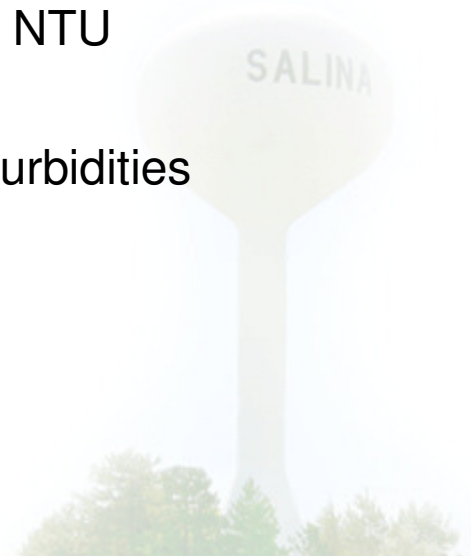
- Water Treatment Plant

- Air strippers

- Limits Downtown Wellfield to 10 MGD (5 MGD with one out of service)
    - Increase capacity to 15.00 MGD
    - Improves reliability and maximizes water right (13.13 MGD)

- River settling basin

- Limited to 8.2 MGD based on KDHE design criteria
    - Not able to treat turbidities greater than 300 NTU
    - Increase capacity to 10 MGD
    - Improve settling capabilities to treat higher turbidities





# Discussion/Questions





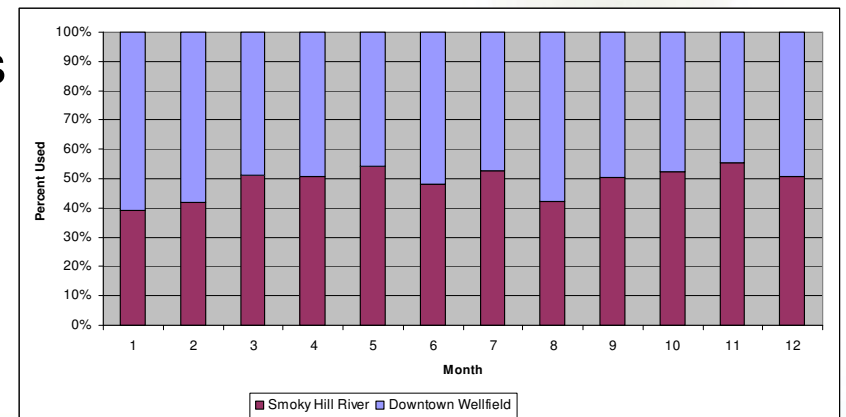
# Conjunctive Use





## Current Supply Use

- In general, 60% surface water 40% groundwater
- Use of surface water dependant on:
  - Turbidity (discontinued if  $> 300$  NTU)
  - Presence of algal blooms (reduce usage)
  - Temperature
- In winter (November - February)
  - Blend 1,000 gpm (2 wells) with surface water
- In summer (June - August)
  - Split is closer to 50/50
  - Due to turbidity/algae issues





## Proposed Procedures

- Maximize the use of surface water
- As demands increase over planning horizon, the existing water right will be fully utilized
- Obtain a seasonal water right on Smoky Hill River

Year	Historical River Usage (gal)	Water Right Limit (gal)	Remaining Annual Volume (gal)	Remaining Annual Average Flow (MGD)
1998	785,296,380	1,638,267,206	852,970,826	2.34
1999	1,030,580,420	1,638,267,206	607,686,786	1.66
2000	840,424,800	1,638,267,206	797,842,406	2.19
2001	1,049,489,240	1,638,267,206	588,777,966	1.61
2002	1,438,460,100	1,638,267,206	199,807,106	0.55
2003	1,406,564,720	1,638,267,206	231,702,486	0.63
2004	1,243,442,400	1,638,267,206	394,824,806	1.08
2005	1,366,941,470	1,638,267,206	271,325,736	0.74
2006	1,283,821,100	1,638,267,206	354,446,106	0.97
2007	1,327,274,980	1,638,267,206	310,992,226	0.85

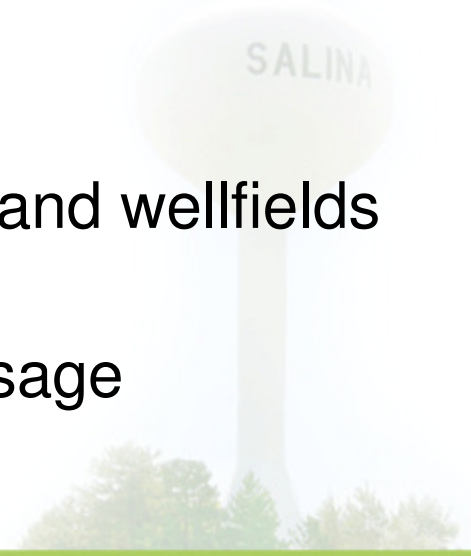




## Proposed Procedures (continued)



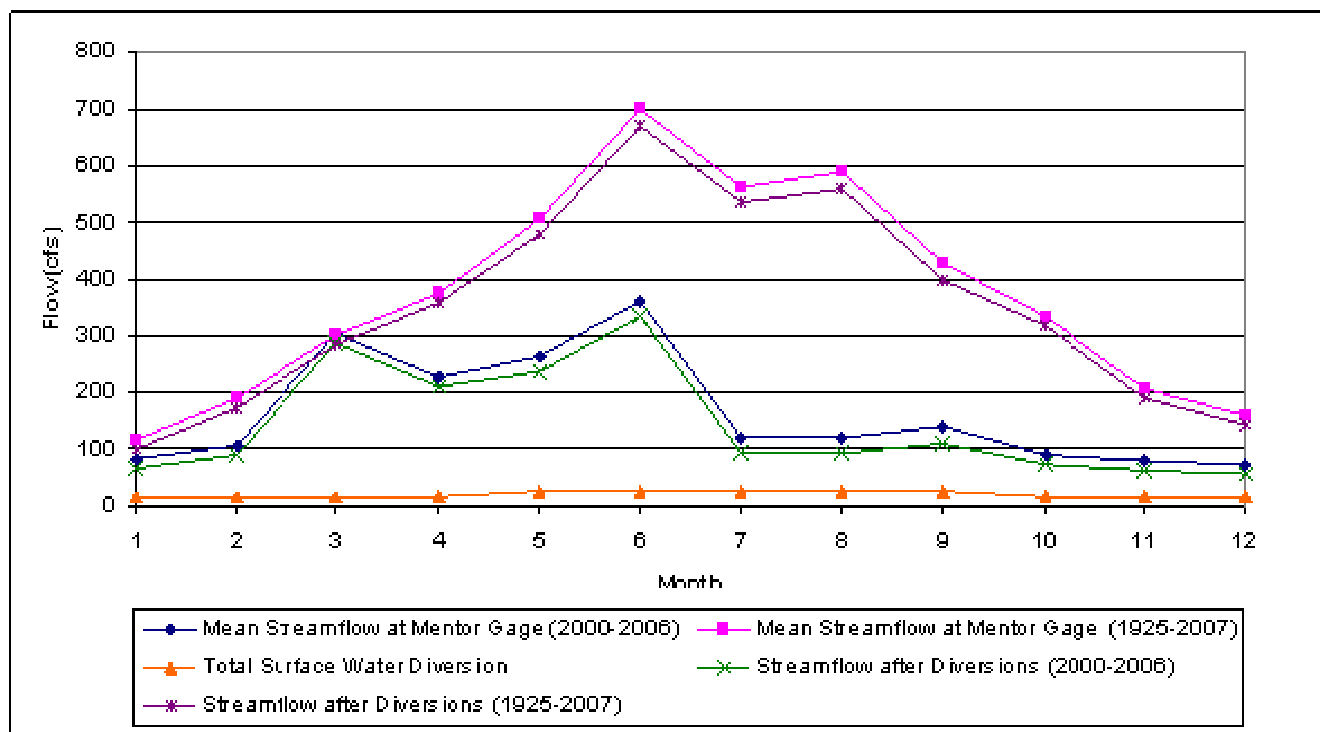
- DWR would likely allow a seasonal water right
  - October through June
- Smoky Hill River is not closed to further appropriations
- Conditioned with a minimum river flow requirement
  - Example – flow greater than 50 cfs at USGS gage at Mentor
  - Does not guarantee City can withdraw everyday
- Use this water right to meet all demands during off-season times
  - Except 1,000 gpm from wellfield to blend
- Save appropriated water right on river and wellfields for peak summer usage
- Preserves aquifer levels for summer usage





# Proposed Procedures (continued)

Obtain a seasonal (“off-season”) water right on Smoky Hill River



Note: Total surface water diversions include maximum diversion Rate for upstream irrigators (May-Sept) and the City’s 2060 average demand



# Discussion/Questions





# Artificial Recharge Potential

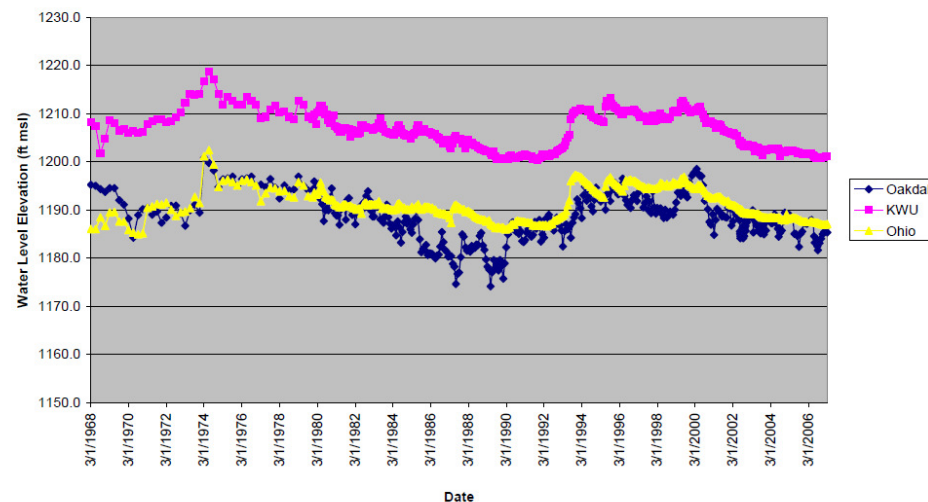




# Artificial Recharge Objectives



- Maintain elevated water levels within the aquifer so that water is available when it is needed
- Two methods:
  - Passive recharge: maximize the use of surface water in order to reserve aquifer levels
  - Active recharge: infiltrate or directly inject water into the aquifer to increase water levels





# Passive Recharge



- Obtain a new seasonal surface water diversion
- Use during October – June
- Preserves water in aquifer for peak demand times





## Active Recharge – Option 1



- Recharge using infiltration ponds
- Objective – keep water at surface where it can percolate down to the aquifer
- Prone to siltation problems
- Loses water to evaporation
  - Annual precipitation = 30 inches
  - Lake evaporation = 52 inches
  - Water deficit of 22 inches
- Utilize existing surface water features
  - Johnson sand pits
  - Increases water level in the vicinity of the sand pits only
  - Not located near Downtown Wellfield, one located near South Wellfield
- Requires off-season water right





## Active Recharge – Option 2



- Direct recharge using wells
- Objective – directly inject treated water
- Two alternatives for the water source
  - New off-season water right on Smoky Hill River
  - Bank storage diversion wells
    - Well located 50 to 100 feet from river edge
    - Pump out of aquifer near stream during high flow times
    - Recharge wells located at wellfield
    - Does not require surface water permit
- Requires permit from KDHE
  - Underground Injection Control Class V Permit





## Active Recharge – Option 3



- Recharge using existing oxbow
- Objective – keep water at surface where it can percolate down to the shallow unconfined aquifer
- Requires off-season water right
- Provides aesthetic improvements for the City
  - Friends of the River is interested in restoring the oxbow area
- Infiltration of water through bottom of oxbow may be limited
  - Low permeability silt or clay
  - Cone of depression at Downtown Wellfield may intersect oxbow

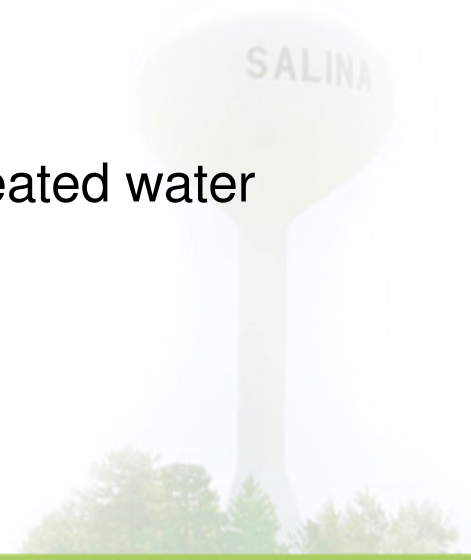




## Active Recharge – Option 4



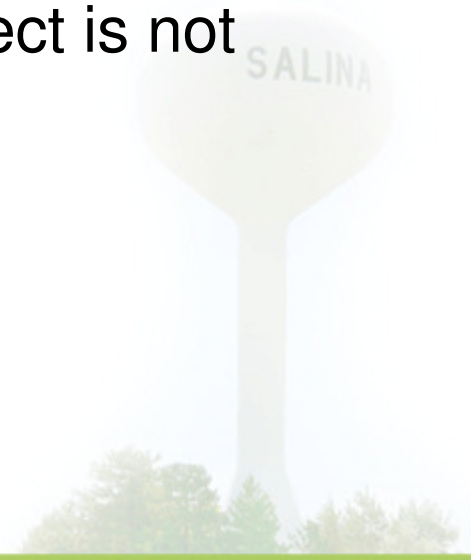
- Aquifer storage and recovery system (ASR)
- Objective – store treated water in another aquifer for future withdrawal
- Has been implemented in Wichita
  - Extracts water from Little Arkansas River during high flows
  - Treat water and put in infiltration ponds – Equus Bed Aquifer
  - Bank diversion wells to directly inject treated water
- Applicability to Salina
  - Alluvial aquifer connected to the river
  - Limited ability of alluvial aquifer to store treated water





# Groundwater Recharge Recommendations

- The following are the options that have the most benefit for Salina:
  - Passive Recharge – obtain an off-season water right on Smoky Hill River to preserve aquifer levels
    - Direct stream flow diversion
    - Bank storage wells
  - Direct Recharge Option 3 – put excess surface water into the oxbow
- Direct recharge similar to Wichita project is not feasible in Salina





# Summary



- Primary goal - maximize the existing infrastructure and supply sources
  - Redrill wells at Downtown Wellfield to maximize water right
  - Implement treatment at South Wellfield and redrill two wells
  - Maximize use of river water during off-season times
    - Preserves aquifer levels
  - Groundwater recharge
    - Passive – maximize use of river water during off-season time
    - Active – utilize existing oxbow to infiltrate water near Downtown Wellfield
- These recommendations will be further evaluated under the Alternatives task
  - Last CAB meeting



## Next Meeting



- December, 2008
- Meeting Topics
  - Conservation Planning
    - Review existing conservation plan
    - Recommended modifications
    - Potential water conservation measures
  - Water Reuse
    - State regulations
    - Water quality and water quantity
    - Application options





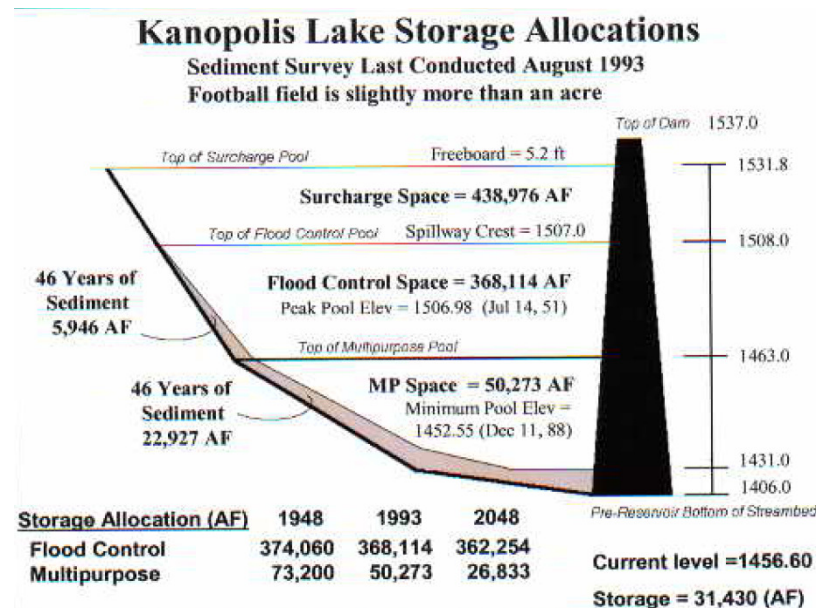
# Discussion/Questions





# Kanopolis Releases

- U.S. Army Corps of Engineers operates Lake
- Water released from water quality storage (part of multi-purpose pool)
  - 53.3% of multi-purpose pool is water quality storage
  - 46.7% of multi-purpose pool is water supply storage
  - Follow minimum release schedule



Month	Flow (cfs)
Jan	10
Feb	10
Ma	15
Apr	20
May	30
Jun	50
Jul	50
Aug	50
Sep	50
Oct	25
Nov	15
Dec	10



## Kanopolis Releases (continued)

- Alternative 2 – improved release schedule

